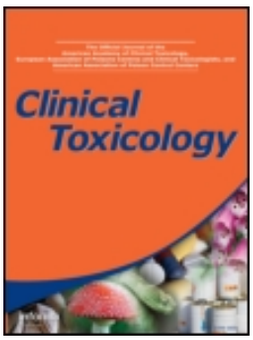

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CRITICAL CARE

Comparison of abdominal computed tomography with and without oral contrast in diagnosis of body packers and body stuffers

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Context. Toxicity due to body packing/pushing/stuffing is a major concern in many countries. Of different imaging techniques, computed tomography (CT) scan is described as the method of choice in detecting body couriers, but there is no study to concomitantly compare with- and without-contrast abdominopelvic CTs to determine the more accurate one for this purpose.*Objective.* We aimed to evaluate the efficacy of abdominopelvic CT "with" and "without" oral contrast in diagnosis of existence, number, and type of packets in body packers/pushers and stuffers. *Materials and methods.* In a prospective observational case series, all suspected cases of body packing/stuffing were included and underwent abdominopelvic CT with and without oral contrast in a one-year period. CT scans were reported by three independent attending radiologists blind to the demographic and clinical results and compared to our defined "gold standard" which was surgery or expulsion of packets. The existence and number of packets detected by each method were compared to define the better method of diagnosis. *Results.* Of 11 suspect body packers/pushers, 10 carried packs. Abdominopelvic CT with and without oral contrast detected six and seven of them, respectively. In 24 body stuffers, CT without oral contrast was more accurate in diagnosis of existence (9/24 vs. 7/24, $p = 0.003$) and number (sensitivity and positive predictive values of 29.2% vs. 37.5% and 100% vs. 100% for CTs with and without oral contrast, respectively, $p = 0.021$). *Discussion and conclusions.* There is a remarkable gap between detection of existence and number of packets/baggies reported by the radiologists and the real condition of the patients. A close teamwork between radiologists and toxicologists is needed to manage these problematic cases.

Keywords Body packer; Body pusher; Body stuffer; CT scan with and without oral contrast; Poisoning; Drug trafficking

Introduction

Body packers and body pushers are those who ingest packs of illicit drugs or put them in their rectum or vagina to transfer the drugs through the legal borders. Body packers tend to ingest packets that contain a large quantity of drug for smuggling, whereas body stuffers usually ingest smaller amounts (1–2 grams) intended for individual sale to evade law enforcement. Most of packets are between 3 and 15 grams and can cause a potentially fatal toxicity if one or more of the packets leak.[1–5]

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Form, size, and density of the packets may depend on the method of their production and packing as well as their impurities.[6–8] The ingredients have different radio-opacities; cannabis is radiopaque, cocaine is isodense, and heroin is radiolucent. Cocaine and heroin may also be denser or more hypodense than feces. However, the major influencing factor is the compression grade, admixture of substance used for cutting, the wrapping and purity, and finally, the consistency of the illicit substance. Upright imaging may help in diagnosis as the small pellet recently ingested may still float in the stomach content. While plain radiographs are frequently recommended, they are not highly sensitive. Computed tomography (CT) has a high reported sensitivity (96%), but the effect of contrast on the efficacy of CT to detect drug packets has not been explored.[9–11] We aimed to evaluate the accuracy of abdominopelvic CT with and without oral

contrast in diagnosis of body packing/stuffing and determine which one of these two protocols was a better tool for such purpose.

Methods

Location and subjects

Loghman-Hakim hospital is a large academic and referral poison center including medical, surgical, and toxicology units. The toxicology unit serves a population of more than 12.5 million and has an annual emergency department (ED) census of more than 30,000 with near 14,000 hospital admissions for poisoned patients.[12] All suspected body packers/pushers/stuffers who were referred to our ED between January 2012 and February 2013 were included. In accordance with the literature, "body stuffers" were defined as those who ingested small amounts of illicit drugs (1–2 grams) intended for individual sale or to evade law enforcement. Those who ingested or inserted larger amounts of packed illicit drugs in their rectum or vagina were called "body packer" or "body pusher" based on the route of concealment.

Study design

To receive a sequence of two different diagnostic interventions in all patients within almost 2 h, a prospective observational case series was designed.

Data collection

We initially identified all patients or their attendance or legal authorities who claimed the patient had ingested at least a pack of illicit drug. They were considered as potential patients and interviewed by a research assistant to document their demographic and clinical characteristics. After explaining the project and its possible benefits and harms for the participants, an informed written consent was taken from each patient.

Those with decreased level of consciousness who could not give written consent forms on admission (unless they became awake after antidote administration and/or supportive care) and those who did not give consent to undergo abdominal CT with and without oral contrast were excluded. Data was constantly recorded until hospital discharge or death.

Interventions

Within almost 2 h, abdominopelvic CT without oral contrast followed by CT with oral contrast was done using a single-slice spiral CT scanner (Shimadzu 7800 SCT scanner, Kyoto, Japan). For the oral contrast, we used 40 cc of 76-percent Meglumine Compound DP (Meglumine Diatrizoate 66% + Sodium Diatrizoate 10%, Daru Pakhsh, Iran) diluted in 1500 cc of water and given during 90 min. All CTs were performed using a voltage of 120 kV, a current–time product of 100 mAs, and slice thickness of 10 mm with the pitch factor of 1.2 in a soft tissue kernel.

Since packers and stuffers could not be differentiated based on their presentation from the beginning of the study, classification of the patients into these two groups was prospectively done.

If the patient had an indication for surgical intervention (obstruction or no response to antidote/conservative treatment), he/she was sent to the operation room, underwent surgery, and the results of the procedure (number of the illicit drug packs/baggies retrieved from the gastrointestinal tract) were recorded. If there was no indication for surgical intervention, the patient was admitted to medical toxicology ward/ICU, received polyethylene glycol and conservative/antidote management, and followed until defecation and expulsion of the packets happened. The packets were collected and counted by police officers on duty who constantly accompanied the patients even in bathroom and investigated fecal materials.

Subjects were analyzed for illicit drugs using urine dipstick screening immunoassay kits for morphine, methadone, buprenorphine, oxycodone, tramadol, propoxyphene, amphetamine, methamphetamine, 3, 4-ethylenedioxymethamphetamine, cocaine, ketamine, phencyclidine, and tetrahydrocannabinol. These tests were used to confirm claimed ingestion/insertion and cross-matched to addiction history, if any.

Radiologic interpretation vs. gold standard

CT findings were interpreted by three independent radiologists with 5 (observer 1), 15 (observer 2), and 3 (observer 3) years of practical experience in abdominal imaging who were blind to the demographic and clinical status of the patients. CT files were anonymous and were sent for six different reading sessions, with 10-day separating intervals in order that the radiologists were not able to compare with- and without-oral contrast CTs. They only knew that these cases might be body stuffers/packers but were not sure about that. Detection of existence (yes/no), average number of packets/baggies, and the average radiological density of packs/baggies (Hounsfield Units [HU]) reported by the radiologists and the real number of them (*gold standard*)—the result of the surgical procedure and/or spontaneous expulsion of the packets—were documented.

Analysis of the outcomes

Any deviation from the "*gold standard*" including overestimation or underestimation of packs/baggies was documented as positive or negative scores to show the intensity of deviation (i.e., − 1 means an underestimation of one pack or + 2 an overestimation of two packs compared to the gold standard). The average number of detected packs was calculated by dividing the total number of detected packs into 3 (radiologists). For example, if two radiologists reported one pack each and the third one reported no pack, the average would be 0.7. For existence of packets (yes vs. no), the most common answers were coded accordingly. If two said yes and one said no, we considered the case as positive. Final

codes and average number of detected packets were used for final analysis.

Sensitivity, specificity, and negative and positive predictive values of the abdominopelvic CTs with and without oral contrast were determined and compared to the "*gold standard"* method of diagnosis.

Statistical analysis was done using statistical package for social sciences (SPSS) software version 17 (SPSS Inc., Chicago, IL, USA) and application of chi-square or Fisher's exact test. Mean or median (interquartile range [IQR]) and Wilcoxon *W* test were applied to compare median estimated number of baggies with real numbers (*gold standard*) in each technique. An interrater reliability analysis using the Kappa (κ) statistic was performed to determine consistency among the three radiologists. Helsinki declaration of the ethics was notified and written informed consent was obtained from all patients. The local ethics committee of our university approved the study.

Results

Demographic characteristics

After initial evaluation of 44 cases, a total of 35 patients were included, of whom 30 (85.7%) were male (Fig. 1). Mean age of the patients was 30 ± 6.8 (range; 16–44) years. Seven patients (20%) had been referred from the prison and seven (20%) from the airport by police force. Police also referred another ten street drug dealers (28.6%) on custody. Seven patients (20%) had themselves referred due to the fear of toxicity. Emergency medical service had found four (11.4%) patients on the street with signs of drug toxicity and referred them, as well.

Median ([IQR], Min–Max) time elapsed between consumption/insertion of the packets and presentation was 8.5 ([3, 24], 1–96) h in body stuffers and 33 ([5, 12], 7–96) h in body packers/pushers ($p = 0.044$). Table 1 shows epidemiological characteristics of the study population.

On presentation to the ED, the most common signs and symptoms were agitation in 16 (45.7%), nausea and vomiting in 13 (37.1%), and hypertension in 9 (25.7%) patients. Table 2 shows on-arrival detailed signs and symptoms in each group of the patients. In 9 patients (25.7%), the pack was sealed while in 26 (74.3%) the pack was loosely wrapped. Ingredient of the packs is presented in Tables 1 and 2. Median [IQR] time elapsed between ingestion/insertion of the packs and hospital presentation was 9 [5, 48] (range: 1–120) h and median [IQR] number of the inserted packs was 2 [1, 9] (range; 1–123 packs) according to patients' claims. Nine patients had previously defecated some of the ingested packs [median (IQR): 10 (2.5–71), range; 1–91 packs] prior to hospital admission.

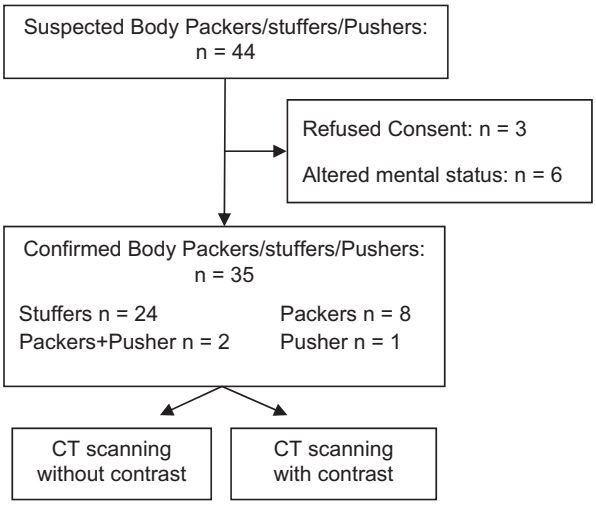

Fig. 1. Selection of participants recruited in the study.

Gold standard and radiologist's interpretation

Mean number of the packs removed by the surgeons during the surgery (in three cases) was 17 ± 15 (range; 2–32) packs.

Median [IQR] number of packs obtained after the surgical procedure or spontaneous expulsion was recorded to be 2 [1, 4] (range; 0–32). The least median [IQR] deviation report on abdominopelvic CT without and with oral contrast was − 1 [− 2, 0] (range; − 27 to + 11) and − 1 [− 3, 0] packs (range; − 29 to + 1), respectively.

Sensitivity, specificity, positive predictive value, and negative predictive value of the CTs with and without oral contrast are shown in Table 3.

In 24 body stuffers, all three radiologists agreed on presence (6 cases) or absence (12 cases) of packets, two radiologists on presence (3 cases), and two radiologists on absence (3 cases) of packets in no-contrast CT study. This agreement was on 3, 14, 4, and 3 cases in contrast CT, respectively. All cases expelled the packets.

In 11 body packers/pushers, all three radiologists agreed on presence (5 cases) or absence (2 cases) of packs, two radiologists on presence (2 cases), and two radiologists on absence (2 cases) of packs in contrast CT study. This agreement was on 5, 3, 1, and 2 cases in contrast CT, respectively. Only 1 patient had no pack.

Median [IQR] number of packs by gold standard technique was 1 [2, 4] (range; 0–32), while median [IQR] number of the reported packs on abdominopelvic CT without oral contrast was 0 [0, 4] (range; 0–23), 0 [0, 3] (range; 0–43), and 1 [0, 5] (range; 0–20) by the 1st, 2nd, and 3rd radiologists, respectively. In evaluation by abdominopelvic CT with oral contrast, the three radiologists reported a median number of 0 [0, 2] (range; 0–20), 0 [0, 1] (range; 0–23), and 1 [0, 3] (range; 0–30), respectively. Table 4 shows the average estimated median (IQR) difference in the number of detected packs/baggies by the radiologists. The interrater reliability (κ) was 0.55 (95% confidence interval [CI]: 0.25–0.84, $p = 0.002$), 0.70 (95% CI: 0.46–0.94, $p < 0.0005$), and 0.64 (95% CI: 0.38–0.89, $p < 0.0005$) for the first and second radiologists (moderate agreement), the first and third radiologists (good agreement), and the second and third radiologists (good agreement), respectively, on presence of packs in oral contrast CTs. These rates were $\kappa = 0.65$ (95% CI: 0.40–0.90, $p < 0.0005$), $\kappa = 0.66$ (95% CI: 0.40–0.91, $p < 0.0005$), and $\kappa = 0.77$ (95% CI: 0.55–0.98, $p < 0.0005$)

Table 1. Demographic characteristics, packets information, urine test results, and number of the packs detected by with- and without-contrast CTs in all 35 cases of the study.

On arrival characteristics							Late characteristics (expelled, late history, CT finding and lab exams)							
												Average packs detected		
Case no.	Age (years)	Sex	Time to hospital (hours)	Dependency	Leak/ rupture	Clinical manifestation	Type†	Route	Drugs	Cover	Urine test results	No contrast	Contrast	Gold standard
1	28	M	5	–	yes	yes	stuffer	oral	stimulant, opioid	nylon	MOP, MTD, AMP, MET	1.3+	2.7+	2
2	27	F	48	heroin	yes	yes	stuffer	oral	stimulant, opioid	nylon	MOP, BUP, AMP, MET	10.3+	4.3+	2
3	28	F	5	crystal heroin	yes	yes	stuffer	oral	stimulant, opioid	nylon	MOP, MTD, AMP, MET	2.3+	0.7−	3
4	37	M	9	crystal heroin	yes	yes	stuffer	oral	stimulant, opioid	nylon	MOP, MTD, AMP, MET	2.3+	0−	3
5	16	M	3	heroin	yes	yes	stuffer	oral	stimulant, opioid	nylon	MOP, AMP, MET	0−	0−	4
6	44	M	2	opium	yes	yes	stuffer	oral	opioid	nylon	MOP	0−	0−	1
7	38	F	24	opium	yes	yes	stuffer	oral	opioid	nylon	MOP	0−	0−	1
8	30	M	4	heroin	yes	yes	stuffer	oral	opioid	nylon	MOP, MTD	0−	0−	2
9	41	M	8	opium	yes	yes	stuffer	oral	opioid	nylon	MOP	3.3+	0−	3
10	42	M	24	opium	yes	yes	stuffer	oral	opioid	nylon	MOP	0−	0−	2
11	29	M	21	–	yes	yes	stuffer	oral	opioid	nylon	MOP	1.7+	1+	1
12	24	M	12	opium	yes	yes	stuffer	oral	opioid	nylon	MOP, MTD	0−	0−	1
13	38	M	48	opium	no	no	stuffer	oral	opioid	nylon	MOP, AMP, MET, THC	4.3+	1.3+	1
14	23	M	1	opium	yes	yes	stuffer	oral	opioid	nylon	MOP, MTD	0−	1.7+	2
15	31	M	7	–	no	no	packer	oral	opioid	nylon	–	3+	1.2+	2
16	27	M	7	–	no	no	packer	oral	opioid	nylon	–	0−	0.3−	9
17	38	M	6	opium	yes	yes	packer	oral	opioid	cellophane	MOP	1.3−	1.3+	31
18	23	M	10	crystal	yes	yes	stuffer	oral	stimulant	nylon	AMP, MET	2−	0−	1
19	33	M	9	crystal	yes	yes	stuffer	oral	stimulant	nylon	AMP, MET	0−	0−	1
20	22	M	6	crystal	yes	yes	stuffer	oral	stimulant	nylon	AMP, MET	0−	0−	1
21	30	M	3	Crystal heroin	yes	yes	stuffer	oral	stimulant	nylon	MOP, AMP, MET	0−	0.3−	1
22	30	M	1	heroin	yes	yes	stuffer	oral	stimulant	zipper bag	AMP, MET	0−	0−	1
23	29	M	1	opium	yes	yes	stuffer	oral	stimulant	nylon	MOP, MET	1.7−	1.7−	1
24	28	M	70	heroin	yes	yes	stuffer	oral	stimulant	nylon	MOP, MTD, AMP, MET, PCP	18.3+	12.3+	2
25	33	M	2	–	yes	yes	stuffer	oral	stimulant	nylon	AMP, MET	0−	0.7−	2
26	24	M	96	Crystal heroin	yes	yes	stuffer	oral	stimulant	nylon	MOP, MTD, AMP, MET	0−	0−	4
27*	24	M	96	–	no	no	packer	oral	stimulant	nylon	MTD	0−	0−	0
28	24	M	96	Crystal heroin	yes	yes	stuffer	oral	stimulant	nylon	MOP, MTD, AMP, MET	0−	0−	4
29	34	F	50	–	yes	yes	packer	Vaginal rectal oral	stimulant	plastic thimbles	MOP, MTD, AMP, MET, PCP	26.7+	24.3+	32
30**	27	M	120	crystal	yes	yes	packer	oral	stimulant	plastic thimbles	AMP, MET, PCP	0.7−	0.7−	18
31	22	M	96	–	no	no	packer	oral	stimulant	nylon	PCP	6−	0−	4
32	38	F	7	opium	yes	yes	packer	rectal	stimulant	plastic thimbles	MOP, MTD, AMP, MET	8.7+	7.3+	8
33	20	M	72	–	yes	yes	packer	oral	stimulant	nylon	AMP, MET	16.7+	16.3+	26
34	30	M	33	Crystal heroin	yes	yes	packer	rectal oral	stimulant, opioid, hallucinogen	plastic thimbles	MOP, AMP, MET	3+	4.3+	4
35	40	M	5	everything	yes	yes	packer	oral	stimulant, opioid, hallucinogen	nylon	AMP, MET, COC	1+	0.3−	7

The table is sorted based on the drug type.
MOP = Morphine, MTD = Methadone, BUP = Buprenorphine, AMP = Amphetamine, MET = Methamphetamine, PCP = Phencyclidine, COC = Cocaine, THC = Tetrahydrocannabinol.
†This classification was prospective.
*This patient referred after complete excretion of the packs.
**One pack was excreted after no-contrast CT.
+ indicates that at least two radiologists agreed on existence of packs/baggies.
− indicates one radiologist or none of them agreed on existence of the packs/baggies.

Table 2. On-arrival signs and symptoms of all 35 patients.

Content	Manifestation	Body packers	Body stuffers	Total
Opioids		(N = 3)	(N = 9)	(N = 12)
	Bradypnea	1 (33.3%)	7 (77.8%)	8 (66.7%)
	LOC*	1 (33.3%)	5 (55.6%)	6 (50%)
	Vomiting	0	6 (66.7%)	6 (50%)
	Nausea	0	6 (66.7%)	6 (50%)
	Hypotension	1 (33.3%)	5 (41.7%)	6 (50%)
	Abdominal Pain	0	1 (11.1%)	1 (8.3%)
	Agitation	0	1 (11.1%)	1 (8.3%)
Stimulants		(N = 6)	(N = 10)	(N = 16)
	Agitation	3 (50%)	7 (70%)	10 (6.3%)
	Headache	2 (33.3%)	6 (60%)	8 (50%)
	Hypertension	3 (50%)	4 (40%)	7 (43.8%)
	Palpitation	2 (33.3%)	4 (40%)	6 (37.5%)
	LOC	1 (16.7%)	4 (40%)	5 (31.3%)
	Nausea	2 (33.3%)	2 (20%)	4 (25%)
	Tachycardia	4 (66.7%)	7 (70%)	3 (18.8%)
	Vomiting	1 (16.7%)	2 (20%)	3 (18.8%)
	Abdominal Pain	1 (16.7%)	1 (10%)	2 (12.5%)
	Seizure	0	2 (20%)	2 (12.5%)
	Hypotension	0	1 (10%)	1 (0.6)
	Hallucination	0	1 (10%)	1 (0.6)
	Dyspnea	0	1 (10%)	1 (0.6)
	Vertigo	0	1 (10%)	1 (0.6)
	Sweating	1 (16.7%)	0	1 (0.6)
Opioids + Stimulants		(N = 0)	(N = 5)	(N = 5)
	LOC	0	4 (80%)	4 (80%)
	Tachycardia	0	3 (60%)	3 (60%)
	Agitation	0	3 (60%)	3 (60%)
	Vomiting	0	3 (60%)	3 (60%)
	Sweating	0	2 (40%)	2 (40%)
	Headache	0	2 (40%)	2 (40%)
	Hypertension	0	2 (40%)	2 (40%)
	Nausea	0	2 (40%)	2 (40%)
	Miotic pupils	0	1 (20%)	1 (20%)
	Palpitation	0	1 (20%)	1 (20%)
	Seizure	0	1 (20%)	1 (20%)
Opioids + Stimulants + Hallucinogens		(N = 2)	(N = 0)	(N = 2)
	Agitation	2 (100%)	0	2 (100%)
	LOC	1 (50%)	0	1 (50%)
	Tachycardia	1 (50%)	0	1 (50%)
	Headache	1 (50%)	0	1 (50%)
	Hypotension	1 (50%)	0	1 (50%)
Total		(N = 11)	(N = 24)	(N = 35)

*LOC = Loss of Consciousness.
Fisher's Exact Test was not significant in any of the groups between body packers and stuffers. It did not include the last 2 groups. There were no repeated measures.

on presence of packs in CTs without oral contrast (good agreement), respectively.

The average median [IQR] HU of detected packs was + 17 [− 26 to + 75] (range; − 66 to + 263) in abdominopelvic CT without oral contrast and + 20 [− 22 to + 60] (range; − 55 to + 569) in abdominopelvic CT with oral contrast. No significant association was found between the HU and detection of the packs by an especial mode of CT to support the hypothesis of better diagnosis of lower-density packs with contrast and vice versa.

Discussion

In recent years, demand for illegal drugs has increased smuggling across the borders and between the cities in Iran which may cause death due to intoxication. Since these acts have severe penalties, taking a history may not be helpful and can even be misleading. Finding the best diagnostic tools would therefore be life-saving.[13,14]

Body stuffers are usually street dealers who hurriedly and unexpectedly hide one or several small packets of illicit drugs in their body cavities when prompted by fear of police arrest.[13] Not surprisingly, in our study, body stuffers were admitted earlier than body packers/pushers. The diagnosis of body packer/stuffer syndrome which results in serious toxicity of packet contents should be considered in any acutely unwell national/international traveler or detained person, especially when associated with agitation/sedation, bradypnea/tachypnea, tachycardia/bradycardia, hypotension/hypertension, miotic/dilated pupils, decreased level of

Table 3. Evaluation of "with" and "without" oral contrast CT in detection of body packers/stuffers + (number of the patients).

Type	Intervention	Test	Gold Standard			Sig*	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
			Positive	Negative	Total					
Body Stuffers	CT with contrast	Positive	(7)	(0)	(7)	0.003	29.2%	–	100%	–
		Negative	(17)	(0)	(17)		12.7–51.1		58.9–100	
		Total	(24)	(0)	(24)					
	CT without contrast	Positive	(9)	(0)	(9)		37.5%	–	100%	–
		Negative	(15)	(0)	(15)		18.8–59.4		66.2–100	
		Total	(24)	(0)	(24)					
Body packers/pushers	CT with contrast	Positive	(6)	(0)	(6)	NS	60%	20%	100%	100%
		Negative	(5)	(1)	(4)		26.4–87.6	3.3–71.2	54.1–100	16.6–100
		Total	(11)	(1)	(10)					
	CT without contrast	Positive	(7)	(0)	(7)		70%	25%	100%	100%
		Negative	(4)	(1)	(3)		34.8–93	4.1–79.7	58.9–100	16.6–100
		Total	(11)	(1)	(10)					

Evaluations were performed with attention to the Gold Standard and Test results for every single patient**.** Only the CT findings (and not clinical & lab data) are used in any analysis.
*Applying Fisher's Exact Test.

consciousness, collapse, gastrointestinal symptoms, and/or seizure. Similar scenario was reviewed by Booker et al.[13] In such circumstances, it would be difficult to distinguish between a simple drug abuse and a body packer- or stuffer-related toxicity.

Therefore, given the legal limitations and poor history provided by the patients, finding an accurate diagnostic tool may be important and life-saving in these patients.

Although abdominopelvic CT is the most accurate method of diagnosis of body packing/stuffing, there is little evidence to determine if "with" or "without" oral contrast method is the optional method for such purpose.[6,14–16]

In a study by Taheri et al. on 12 patients, abdominopelvic CT without oral contrast was introduced as the method of choice in diagnosis of these patients.[17] In another study by Sohail, abdominopelvic CT with oral contrast was reported to be positive in only 6 out of 11 patients while all packets had high densities.[18] Ichikawa et al. reported that cocaine and cannabis were clearly obvious and diagnosed in abdominal radiography and CT (high-density/double condom sign). However, heroin was not clear in the plain abdominal radiography and CT was preferably used by the authors to diagnose its packet ingestion.[19] Although abdominopelvic CT with oral contrast had a high sensitivity in diagnosis of body packing and stuffing in the study by Prabhu et al., the authors mentioned that its use was limited because of the impurities in the packaged drug that changed its density.[14] Although we could not find a significant difference in the density of the packs/baggies between the CTs performed with and without oral contrast, we think that the less efficacy of CT "with" oral contrast may be due to the higher impurity of the packs/baggies in our series. Such impurities are definitely more prominent in the body stuffers which again explain the cause of less efficacy of oral contrast CT in stuffers. This can be further investigated in future studies with larger sample sizes.

According to our results, CT without oral contrast is a better option for diagnosis of body stuffing. This may be explained by the fact that the density of the baggie is close to the ingested oral contrast and this similarity prevents accurate diagnosis between the baggie and oral contrast Therefore, the diagnosis can be more easily made by CT without oral contrast (Fig. 2).

Since packers and stuffers could not be differentiated based on their presentation from the beginning of the study, classification of the patients into these two groups was prospectively done. Non-contrast CTs had a higher sensitivity and higher negative predictive value in comparison with the oral contrast CTs. Abdominopelvic CT without oral contrast could diagnose 70% of the body packers and 37.5% of the body stuffers, while these rates were 60% and 29.2% for CT with oral contrast, respectively. As demonstrated in Table 1, only one body stuffer (case no. 14) and one body packer (case no. 17) benefitted from adding oral contrast to previous no-contrast CT (raised sensitivity from 37.5% to 41.6% and 70% to 80%, respectively). This may not be clinically valuable in the management of the patients.

Using non-contrast CTs as the best tool in similar cases was confirmed by Cranston et al. who suggested that oral administration of contrast medium did not improve detection

Table 4. Average estimated Median [(IQR), Min–Max] difference in number of detected packs/baggies by three radiologists.

	Body stuffers ($n = 24$)		P value*	Body packers ($n = 11$)		P value*
Technique Difference	CT without oral contrast − 0.083(− 1–0.58), − 4–16.33	CT with oral contrast − 1(− 2–0.85), − 4–10.33	0.021	CT without oral contrast − 1(− 9.4–1), − 29.67–5.34	CT with oral contrast − 6.7(− 9.7–0.7), − 29.67–0.33	NS

Perfect diagnosis (gold standard) is considered 0 (no deviation/exact diagnosis). Any deviation toward positive shows overestimation and negative shows underestimation in real median number of the packs/baggies.

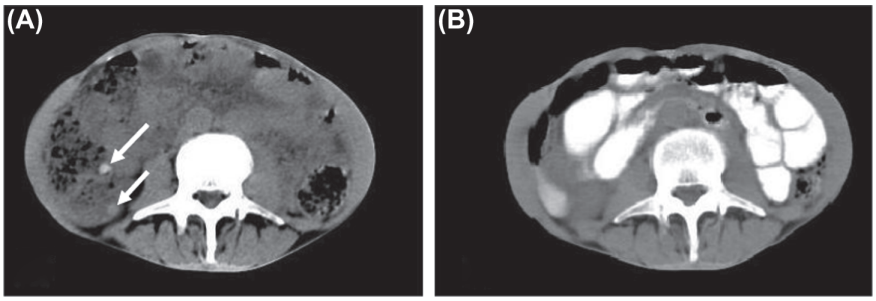

Fig. 2. (A) Abdominal CT image of a body stuffer without oral contrast shows two small packets (white arrows) in the ascending colon which is then obscured by the ingested oral contrast in next CT image (B).

of ingested crack cocaine.[20] It was concluded that CT without oral contrast was generally a better method in comparison with contrast CT (Table 3); however, neither of these methods could accurately determine the existence and number of the packs. There are multiple studies in which sensitivity (77–100%) and specificity (94.1–100%) of CT were higher than ours.[6,21,22] The probable cause is the limited number of the ingested packs (particularly in body stuffers) and different sizes and shapes of the packs compared to the uniform packs in many other previous studies. Another cause that may have affected our interpretations is the experience of the reporting radiologists.[13]

In total, 92% of the body stuffers were diagnosed in this series, in 80% and 36% of whom, clinical manifestations and urine tests were helpful in making the final diagnosis, respectively. In comparison, 90% of the body packers/pushers were diagnosed using radiological imaging and adjunctive modalities (urine tests and clinical manifestations), but CT scan—as the sole method of diagnosis without using adjunctive methods—was more helpful in diagnosing the body packers/pushers. Urine tests may be affected due to contaminated outer packets, semipermeable wrappings, or previous recreational use. Following an initial negative test, serial testing may determine packet breakdown and further poisoning.[13]

Limitations

A limitation of the current study is that the data obtained on the number and type of the packets expelled before hospital admission was taken based on the history given by the patients themselves and accuracy of the reported data could not be confirmed. Another potential limitation is misguiding of the patients in giving history on the type and number of the packs ingested/inserted and history of addiction that can impair the diagnosis and treatment. Using abdominopelvic CT with and without oral contrast and diagnostic urine kits may help resolve such diagnostic problems in these patients.

We had also limitations on defining the "gold standard" to show the real number of packs because drug packs are small in size, mostly have no indication for surgery, and even in the case of surgery, may be ignored during the operation, particularly in body stuffers.[23]

Also, using an old CT device with 10-mm slices may be a limitation. Actually, a scanner with higher resolution might have yielded better results. The relatively low Kappa suggested that the test might be radiologist dependent.

The single negative subject of this study (case no. 27) obviously limits our assessment of false positives resulting in the fact that the specificity was not well determined and might not be generalized.

Conclusions

In the concomitant evaluation of the abdominopelvic CT "with" and "without" oral contrast, CT without oral contrast was determined to be a better diagnostic tool, especially in body packers/pushers. Abdominal CT without oral contrast was even a better option in diagnosis of baggies in the body stuffers. In suspicious cases, other methods of confirmation including clinical manifestations and Eliza tests for drugs of abuse may reduce misinterpretations. A close teamwork between radiologists and toxicologists is needed to manage these problematic cases.

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Declaration of interest

The authors report no declarations of interest. The authors alone are responsible for the content and writing of the paper.

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